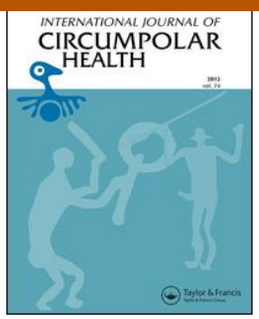

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ORIGINAL RESEARCH ARTICLE

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How occupational health is assessed in mine workers in Murmansk Oblast

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Objectives. We aimed to describe how work exposure and occupational health is assessed for mine workers in Murmansk Oblast, Russia.

Study design. A descriptive study based on current practice, laws and available literature.

Methods. The information and data were obtained from scientific publications, reports, regional and federal statistics, legal documents, through personal visits and onsite inspections.

Results. Several institutions are involved in these assessments, but all mine workers have been examined by specialists at one institution, which helps to ensure that the work is of stable quality and adds reliability value to the numbers. Workplace risks are assigned hazard grades, which influence the frequency of periodic medical examinations and salary levels. The examinations are aimed to diagnose latent or manifest occupational disease. This may lead to relocation to a workplace with lower exposure levels, free medical treatment, compensation and a lower pension age.

Conclusions. Regulations and systems to protect the health of mine workers have more emphasis on control and repair than on prevention. Since relocation can lower the salary, some workers may under-report medical problems. To what degree this happens is unknown. The mining enterprises pay the medical service provider for periodic medical examinations, which could potentially weaken their independent role. This framework is important to understand when studying and assessing the health of working populations in the circumpolar region.

Keywords: *occupational health*; *work environment*; *mine workers*; *Russia*; *Murmansk Oblast*

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Working as a miner is associated with health impairment and mortality from factors in the work environment (1). This affects the individual, the mining enterprise and society as a whole. The Barents region is the most important mining area in Europe. The many large mines located in the Kola Peninsula make this region (Murmansk Oblast, MO) the most heavily industrialised region in the Russian Federation (RF). The MO's population of 794.800 constitutes only 0.6% of the total population of RF (2), but 21% of the population in the circumpolar north. Industrialisation and militarisation have urbanised the MO with 92.8% living in cities and towns (3) compared to 73% in the RF (2). Thirty-seven percent of the MO population lives in Murmansk city; the rest of the urban population lives in industrial towns or "monogorods" based on a single industrial plant, which provides employment and community services (Table I). Considering the relative magnitude of this industrial population, the health implications of working conditions in MO are large in an Arctic public health perspective.

The apatite mining and processing complex of the company Joint Stock Company (JSC) Apatit forms an industrial cluster in Kirovsk and Apatity (Fig. 1). The company's activities include the extraction and transport of ore and the physical and chemical processes that make phosphate-rich concentrate (4). Founded as a state enterprise in 1929, this industry was later privatized and adapted to the global market economy. Between 1950 and 1990, the annual ore extraction increased from 3 to 55 million metric tons (5), and the company is currently one of the largest producers of phosphate in the world.

Both working conditions and climate have posed challenges to the health and safety of the mine workers.

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Table I. Main industrial towns and industry in Murmansk Oblast

Industrial town	Main industry
Polarnye Zori	Nuclear energy
Nikel	Nickel mine and smelters
Monchegorsk	Nickel and copper refineries
Kirovsk	Apatite-nepheline mines
Apatity	Ore processing plant
Kovdor	Iron, apatite, mixed ore mines, ore processing plant
Olenegorsk	Iron mines, smelters
Khandalaksja	Aluminum smelters
Zapoljarny	Nickel mine, concentrate production plant
Revda	Rare earth metals, titanium mines

After the use of forced labour in the mining industry was abandoned in the late 1950s, the focus on occupational health and safety increased (6), with both research on and diagnosis of occupational diseases. These are medical conditions considered to be caused by exposures at the workplace and may qualify the worker for compensation or have other consequences.

Occupational health in MO

The incidence of occupational disease in MO has increased during the past decade, after a downwards trend during the preceding years. The incidence in 2006 was twice that in 1999, passing the level in RF. This is also the trend in the industrial towns of MO (7). The most common causes (36.6%) of occupational disease were noise and vibration (8). Musculoskeletal problems and diseases secondary to mechanical vibration have been identified as the most frequent health problems in Kola mine workers. Only 12% of miners working underground and 13.6% of miners working in open mines had never been diagnosed with some form of medical condition (9). The number of accidents decreased over the period 1991–2003 (10).

An improved understanding of how occupational health and risk is assessed in MO is crucial in order to explain mine workers' health in the region and to be able to compare different regions within the circumpolar north in terms of occupational health and overall morbidity. The aim of this study was to describe how occupational health and work exposure is assessed for mine workers in MO.

Material and methods

Information and data were obtained starting from search on PubMed for scientific publications, using combinations of the search words "occupational health," "Russia," "north," "Kola" and "assessment." Of the articles available on PubMed, the majority were in Russian language, with English abstracts only, and not available in full text online. Some 20 were published in

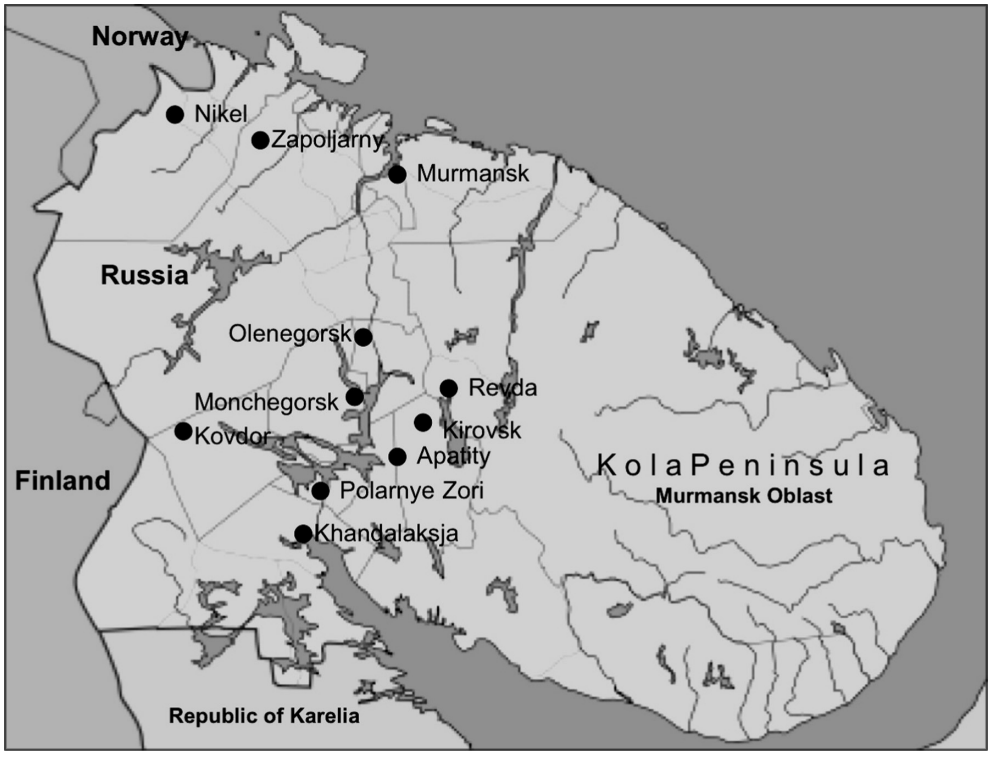

Fig. 1. Industrial towns and Murmansk city in Murmansk Oblast.

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Occupational Medicine and Industrial Ecology/Meditsina Truda i Promyshlennaya Ecologiya. The articles were collected in full text in analog libraries at occupational health institutions in Russia and, working together with Russian colleges, their relevant content was translated to English language. In addition, we carried out a manual search for relevant publications issued during the last 5 years (2006–2010) in *Human ecology/Ekologiya cheloveka*, which is another major journal for occupational health in northwest Russia, but not indexed in PubMed. In addition to information from scientific journals, search was carried out in other online sources for reports, available regional and federal statistics and legal documents governing the assessment of workers' exposure and occupational health in the RF (laws, orders, standards and regulations). Information was also obtained at the central institution for occupational health in MO from documents and reports that are not online but are central to this topic. Information on workplace condition evaluation and assessment was also obtained from onsite inspections in the mines together with those Russian occupational health specialists who are carrying out the assessment of occupational health in mine workers in this region. We describe the system and principles for diagnosis and assessment of occupational disease and the principles for workplace risk assessment and hazard grading. However, a full description of the procedures for diagnosing occupational diseases and calculating hazard grades is beyond the scope of this study. The legal framework is only mentioned in general terms. No ethical approval was needed for this study since no observation of individuals was included in the material.

Context

Apatity and Kirovsk have a combined population of 110,000; a decrease of 20% since 1990 (2). The apatite-nepheline mining and processing enterprise JSC Apatit operates 4 mines, transportation lines and 2 concentrate plants in the area. JSC Apatit employs 13,500 workers (20% of all industrial workers in MO), of which some 4,000 are directly employed in mining (Table II). Women constitute 5.5% of the employees and 85% are ethnic Russians (10).

Table II. Mines and number of mine workers in Kirovsk

Mine	Type	Number of workers (2010)
Kirovsky	Underground	2,034
Vostochny	Open pit	650
Zentralny	Open pit/underground	587
Rasvumchorrsky	Underground	676
Total		3,947

Joint Stock Company Apatit also runs public transport, several leisure and sports complexes and a sanatorium for recreation and rehabilitation of its workers. There is also an education program for future miners at the Khibiny Technical College in Kirovsk. In contrast to the early years of this mining community, Kirovsk is now a more demographically diverse community.

Results

Work exposure risk assessment, disease prevention, diagnosis of occupational disease and adjudication of compensation issues are central elements in the health care system for workers in MO. Several institutions are involved. The mine workers undergo an annual health examination with thorough anamnesis and clinical investigations and tests involving physicians specialized on various organ systems. A committee of doctors concludes whether a medical condition should be classed as a confirmed occupational disease, a suspected occupational disease (person in an "at risk group"), or a non-occupational disease. For the worker, this can lead to relocation, compensation or coverage of medical treatment. These health and workplace assessments are performed on both a local and regional level and involve the institutions described below.

Rospotrebnadzor

This is the regional body of the Russian Board of Health Supervision and has the authority to intervene to improve conditions in a workplace and to shut it down (11). The institution provides annual reports for every region and education programs in occupational health.

Centers for epidemiology and hygienic surveillance

These centers exist on local and regional levels (located in Kirovsk, Monchegorsk and Murmansk) and assess risk factors in workplaces. The findings are used in the characterization of workplace environment and then related to health conditions (details follow below).

Kola Research Laboratory for Occupational Health (KRLOH)

The KRLOH is the Kola Peninsula branch of the Northwest Public Health Research Center in St. Petersburg and is the central institution for competence and assessment regarding workers' conditions and health in MO. The KRLOH also runs out- and in-patient clinics, a research department and a clinical chemical laboratory. The staff includes physicians specialized in occupational health. It is funded through the budget of the federal Northwest Public Health Research Center and by payments from the enterprises that make use of the specialist services. The KRLOH receives workers from several mines in the region: the 4 apatite mines in Kirovsk (Table II), the Kaula Kotselvaara mine in Nikel, the Severny mines in Zapoljarny and from mines

in Kovdor. The workers spend 1 day at the KRLOH with full pay. The examination includes laboratory tests and clinical examination by organ specialists and specialists in occupational medicine; data are recorded on a standardized chart and entered into an electronic database. Information on the exposure characteristics of each type of workplace is also available at KRLOH. This is used for assessments of associations between exposure and disease. KRLOH cooperates closely with specialists at the municipal hospital in Kirovsk in diagnostics and treatment and can refer workers to the local sanatorium. KRLOH also sends specialized staff and equipment to carry out periodical medical examination in nearby industrial towns (so-called "komandirovka"). KRLOH's access to the industry, the workplaces and the workers is regulated through federal law (12), and it reports occupational health statistics to the Federal State Statistics Service (Goskomstat) and to Rospotrebnadzor.

Medical institutions authorized for medical examination of workers in MO

In addition to KRLOH, the municipal hospitals in Monchegorsk, Zapoljarny and Olenegorsk are authorized to perform regular medical examinations of workers. However, no miners are examined in the Monchegorsk hospital (as no miners live and work in the Monchegorsk area). The assessment of workers' health consists of both an initial medical examination and periodic check-ups. These are conducted according to federal laws (12,13) and decree (14). These medical examinations include all employees, though at different intervals. Potential new employees undergo pre-employment examinations to check if whether they fill the medical requirements. The assessed risk in the work environment determines the frequency of later periodic examinations: every year or every fifth year. If municipal hospitals do not have the full team of specialists to fulfill the legal requirements, they must invite specialists from other qualified institutions. Miners who have their check-ups at municipal hospitals are also examined by specialists from KRLOH every fifth year, as a minimum requirement (14). Approved institutions outside MO can also compete for the contract to conduct periodic medical examinations. Although this has not yet happened, Rospotrebnadzor has expressed concerns over the possibility that such examinations might be of lower quality (11). The central documents governing the field of occupational health are presented in Table III. Note that a guideline has been developed for the assessment of occupational health in a regional context.

Assessment of work environment

The Center for Epidemiology and Hygienic Surveillance carries out characterization of working conditions. For each profession and workplace, there is a list of factors (physical, biological, chemical and psychosocial) that are measured or quantified. This characterization provides the basis for the KRLOH's assessment of workplace risk. The weighted sum of the factors is used to calculate hazard grades from 0 to 4 (15). The interpretation of the numerical values of hazard grades is listed in Table IV. Additional details concerning hazard grades in the mining industry have been presented by Chaschin and Askarova (16).

Calculated hazard grade for WBV has been 3.1–3.2 for load-haul-dump vehicle drivers in an underground mine in Kirovsk (17). For other groups of underground mine workers, vibration levels corresponded to hazard grade 2–3.3 (18). The hazard grades do not correspond directly with the European limit and action values. However, yet unpublished comparative studies indicate that the whole body vibration exposure levels classed as hazard grade 3.2 in load-haul-dump vehicles are similar to the limit value in the European system (19). The Order № 90 (14) states which hazard grades can be allowed for various professions and workplaces. Hazard grades are also part of the basis for calculation of salary, with higher hazard grades rendering higher pay. Work at hazard grade 4 is only allowed for short time periods, as in emergency situations.

Table III. The main regulations governing the occupational health issues in Russian Federation

Type of document	Title
Federal laws	Federal Law № 181-FL on November 24 1995 (12); Federal Law of March 30 1999, № 52-FZ (13).
Federal decree order	The order of the Ministry of Public Health and Medical Industry № 90 on 14.03.1996 (14).
Federal sanitary norm	Guide on Hygienic Assessment of Factors of Working Environment and Work Load. Criteria and Classification of Working Conditions, Guide P 2.2.2006 – 05 (15).
Regional methodical medical recommendations	Methodical recommendations: Organization of pre- and periodic examinations of the people who are working for enterprises and institutions and being exposed to dangerous and harmful industrial factors. Methodical recommendations for treatment- and prophylactic institutions, state sanitary-epidemiological supervision centers and departments of labour protection and safety of the Murmansk region enterprises (20).

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Table IV. Grading system for assessment of health hazard

Hazard grade	Interpretation
0	No exposure to health hazardous factors
1	Exposure without health hazard
2	Exposure with acceptable health hazard
3.1, 3.2, 3.3, 3.4	Exposures with increasing health hazard
4	Exposure with high/extreme hazard

Medical examination of mine workers

Pre-employment examination

This is carried out to assess whether an applicant is medically fit. All categories of workplaces are listed in the Order № 90 with corresponding medical recommendations and conditions that disqualify for employment (14). As mentioned, all workplaces are characterized in terms of hazard grades, and these grades are compared with the medical profile of the person seeking employment. The Order № 90 also specifies which clinical and laboratory tests and specialist examinations are required. A medical profile is compiled from the results. The document follows the worker throughout his or her career and is updated at later medical examinations.

Periodic medical examination

All workers have to undergo periodic medical check-ups to renew their work certificates at a frequency that depends on the hazard grade of the individual's workplace. Employees with an overall hazard grade of 3.1 or more undergo medical examination annually, while employees with hazard grade 2 or below have an examination every fifth year. The Order № 90 lists the examinations, equipment, clinical and laboratory tests and specialists required for these check-ups (14). KRLOH has assembled and published the methodical recommendations for medical examinations, how to interpret the results of the periodic medical examinations and how to prepare individual medical advice (20). The purpose of the check-up is to identify possible occupational disease during the period of employment. The findings may affect the worker's possibility to continue in the work position. There are 3 possible outcomes (recommendations) from this periodic check-up: (a) if no work-related health problems are found, the employee can continue to work, (b) if the check-up suggest that the employee may be developing occupational disease, the employee cannot continue to work in the current work environment and should be relocated and (c) if a condition is diagnosed and approved as being occupational disease, the employee should be relocated and can apply for compensation. These final decisions are based on a wide set of information, evaluated by a consultative group of 8 doctors. The group consists of the chief and deputy physician and physicians in several specialties, as specified in the Order № 90. Their main tasks are to identify pathological conditions at an early stage and to prevent a condition from progressing through advice and relocation. The examining institution receives payment from the workers' employer for the work (14).

For a medical condition to be approved as occupational disease, 4 conditions must be present: (a) the condition must be among the diseases that may qualify, as listed in the Order № 90, (b) the exposure must be known to be present in the work environment, (c) this exposure must have a recognized causal link to the disease in question and finally, (d) the exposure must precede the onset of disease by a reasonable amount of time. These conditions must be considered and assessed in institutions that are specialized in occupational medicine (14), such as KRLOH in the case of mine workers in MO. The consultative group of doctors decides whether the criteria are met. If the condition is considered to meet the criteria and is approved as an occupational disease, the worker must apply for occupational disease compensation from the government. Workers who have private insurance may apply for compensation as well, but such insurance is not mandatory. A person with an occupational disease is entitled to a 1-time compensation payout. The decision whether to grant compensation is made by the local special medical social committee MSEK (Russian abbreviation МСЭК). A negative local ruling can be reassessed at the regional level in MO or appealed to the MSEK committees in St. Petersburg or Moscow (14). The level of disability is graded as: (a) disability that precludes work, (b) disability that does not preclude work and (c) reversible disability that does not preclude work but necessitates relocation. Doctors may be subject to compensation claims if a worker who is exposed to hazardous factors at the workplace is not relocated due to mistakes or negligence on the part of the doctors and goes on to develop an occupational disease.

Hazard grades of 3.1 and above can motivate relocation of persons at particular risk of developing an occupational disease to a workplace where exposure to the harmful factor is lower. If possible, the worker is relocated within the same company. The employee is obliged to accept relocation. Failure to do so may lead to loss of rights to receive compensation. If no suitable position is available, the person can be laid off. If relocation or loss of job leads to a reduction or loss of salary, this is partly compensated by monthly payments (14). Being diagnosed with an occupational disease will also lead to a lower retirement age and a higher pension. However, the pension is less than the salary of a mine worker, especially if the workplace environment has high hazard grades. The diagnosis will qualify the worker for free treatment of the occupational disease, also in sanatoriums (12,13). Workers with an occupational

disease that is considered to be in an early stage can be referred for early intervention to prevent further progress or to reverse a pathological process. Workers may also be referred by physicians to other sanatoriums or to health resorts.

Discussion

This study provides insight into how occupational health is organized and assessed in MO, both in general and in mine workers specifically, and how the official figures on occupational health are collected. Given the large and growing number of mine workers in the region, this is a topic of high relevance when studying health issues and interpreting health indicators in this population. Occupational health of mine workers in MO is investigated through a battery of tests and examinations of individual health and workplace. These systematic procedures can affect the mine workers medically and economically, as there are both advantages and disadvantages to being diagnosed with occupational disease or working in an environment with a health hazard. If a work environment is declared hazardous to health, this would increase the worker's salary or cause relocation, rather than obliging the employer to reduce the exposure to safe levels, as in most other European countries. Relocation might be an expression of a greater focus on recuperation from than on prevention of health problems.

Since relocation to a work environment with lower hazard grades leads to lower salary, the system could make the workers prone to conceal their health problems by under-reporting or even taking medication prior to the examination to improve test results. This applies especially to medical conditions for which the diagnosis is based on information from the employees themselves and not on objective tests. To what degree the built-in mechanisms in the system have led to under-ascertainment of disease and injury would be difficult to evaluate. The character of the periodic medical examinations is control based and mandatory rather than based on trust. This does not solve the issue of possible under-reporting. The system does provide employees with extensive health assessments, which may be regarded as a fringe benefit. Still, this check-up activity might also take place at the expense of prophylactic approaches (21). Some employers, feeling they have little to gain from the annual examination, might have made little effort to facilitate the examination. In practice, many smaller firms have not been offering the medical examinations as legislated (11). In the mine industry in the MO, however, the medical examinations have been a part of the workplace routine and the participation rates of both employers and employees have been high. In KRLOH, the MO appears to have a well-qualified center to perform periodic medical examinations of mine workers and diagnose occupational disease, as the staff at KRLOH has the required skills and experience. However, since the occupational health institutions receive payment for these examinations from the employer, there is a risk of financial dependency in this relationship. Thus, the free and independent status of the medical institutions performing the medical assessment of workers could be undermined. The number of workers diagnosed with occupational disease might therefore depend not only on hazardous exposure levels in the workplaces but also on factors arising from the relationships between the enterprise, employees and the medical institutions (18).

Despite the past decade's improvements in work conditions due to more modern technology, exposure levels have remained high. The Russian norms for exposure levels were exceeded in MO for 39% of male and 25% of female workers (9). In addition, methodological factors (improvements in diagnosis, occupational health care systems and registration regimes at KRLOH) might explain the observed increase in number of cases of approved occupational disease in this mining population (7). However, the fact that the medical examinations of most mine workers in MO have been performed by a single institution implies stable quality and continuity of the work and gives added value to the numbers. MO adheres to the same legal framework as all of the RF, so our findings concerning requirements, procedures and standards can be generalized to the rest of the country. The main limitation of the study has been the poor availability of information sources. Internationally published information is very scarce, and material published in Russia is not readily located through databases and usually not accessible electronically. Therefore, we also have used informants.

Our findings concerning the regulations, procedures and institutions involved in the assessment of occupational health and work places in MO show the importance of understanding this framework when studying the health of working populations and interpreting official health statistics in the circumpolar regions and countries. Our study disclosed the existence of thorough regulations and well-established systems to protect and follow up the health of workers in mines and industry in Russia. However, the system appears to emphasise control and repair more than prevention of occupational disease and injury. The economic incentives for the workers and the close economic ties between the medical institutions that provide the check-ups and the mining enterprises in MO may not be optimal for protection of health of this population of workers.

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Two of the authors (Siurin and Talykova) are employed in one of the institutions presented in the study.

References

1. Donoghue AM. Occupational health hazards in mining: an overview. Occup Med. 2004;54:283–9.
2. Russian Federation Federal State Statistics Service. The demographic Yearbook of Russia 2010, Statistical Handbook. Moscow: Russian Federation Federal State Statistics Service; 2010 [cited 2012 Mar 27]. Available from: http://www.gks.ru/wps/wcm/connect/rosstat/rosstatsite/main/publishing/catalog/statisticCollections/doc_1137674209312. [In Russian and in English]
3. Young TK. Circumpolar health indicators; sources, data and maps. Circumpolar Health Suppl. 2008;3:1–130.
4. E&MJ, Engineering and Mining Journal. Phosphate mining in the northern dimension. Denver: E&MJ, Engineering and Mining Journal; 2009 [cited 2012 March 27]. Available from: http://www.e-mj.com/index.php/features/616-phosphate-mining-in-the-northern-dimension.html.
5. Luzin GP, Preters M, Vasiliev VV. The Kola Peninsula: geography, history and resources. Arctic. 1994;47:1–15.
6. Rukavishnikov VS, Shaiakhmetov SF, Pankov VA, Kolycheva IV. Zdorov'e rabotnikov gornodobyvayushchei promyshlennosti Sibiri i Krajnego [Health of workers engaged into mining industry in Siberia and Far North]. Med Tr Prom Ekol. 2004;6:6–10. [In Russian]
7. Kola Research Laboratory for Occupational Health. Otsenka professionalnogo riska osnovnykh professiy ob'edinennogo kirovskogo rudnika OAO Apatit [Annual report on occupational diseases and risk factors in workers employed in JSC Apatit]. Kirovsk: Kola Research Laboratory for Occupational Health; 2009. p. 1–18. [In Russian]
8. Skripal BA. Proffessional'naya zabolevaemost' eye osobennosti na predpriyatiyakh gornokhimicheskogo kompleksa Kol'skogo Zapol'yar'ya [Occupational Morbidity, its features on enterprises of mining and chemical complex in Kola Polar Region]. Ekologiya cheloveka [Human Ecology]. 2008;10:26–30. [In Russian]
9. Karnachov IP, Nikanov AN, Palkin VM. Metodologicheskie podkhody k prognoznoj otsenke priemlimogo urovnya riska dlya zdorov'ya rabotayushchikh na gornodobyvayushchikh predpriyatiyakh Murmanskojoblasti [Methodological approaches to prognosticating evaluation of admissible risk level for health of employees at mining enterprises of Murmansk region]. Ekologiya cheloveka [Human Ecology]. 2005;11:46–52. [In Russian]
10. Kuptsov VN, Skripal BA, Efimova TI, Kudryashov AN. Rasprostranyennost chronicheskoy patologii na predpriyatiyakh gornokhimicheskogo kompleksa Kol'skogo Zapolyar'ya. Materialy mezhdunarodnogo simposiuma "Ekologiya i okhrana zdorov'ya rabochikh promyshlenykh predpriyatiy v Barents-raione" [Prevalence of chronic pathology in industrial workers of mining and chemical complex in Kola Polar region. Materials of All-Russian conference 'Environment and health protection of the industrial workers in the Barents Region'.] Apatity: Kola Science Center press; 2008. p. 26–7. [In Russian]
11. Rospotrebnadzor. Gigiena truda i professionalnye zabolevaniya rabotaushchikh [Annual report on the occupational health and safety situation, Occupational hygiene and professional work diseases]. Murmansk: Rospotrebnadzor; 2009. p. 58–73. [In Russian]
12. Federal'nyi zakoni № 181-FZ ot 24 nojabr'ya 1995 goda "O sotcial'noy zashchite invalidov v Rossiyskoy Federatsii" [Federal Law № 181-FL of November 24 1995 "On social insurance of disabled people in Russian Federation"]. [In Russian]
13. Federalnyi zakon ot 30 marta 1999 goda N 52-FZ "O sanitarno-epidemiologicheskom blagosostoyanii naselenija" (s izmenenyami I Dopolneniyami) [Federal Law of March 30, 1999, № 52-FZ "On the sanitary-epidemiological welfare of population" (with changes and amendments)]. [In Russian]
14. Prikaz Ministerstva Zdravookhraneniya Rossiyskoyi Federatsii. № 90 ot 14.03.1996 [The order of the RF Ministry of Public Health № 90 on 14.03.1996]. [In Russian]
15. Rukovodstvo pio gigienicheskoy otsenke factorov rabochey sredy io trudovogo protsessa, R 2.2.2006 – 05 [Sanitary norm: Guide on Hygienic Assessment of Factors of Working Environment and Work Load. Criteria and Classification of Working Conditions, Guide P 2.2.2006 – 05]. [In Russian]
16. Chaschin VP, Askarova ZF. Apriornyi professionalniy risk dlya zdorov'ya robotnikov gorno-obogatitelnogo predpriyatiya [A priori occupational health risk of an ore-dressing and processing enterprise workers]. Med Tr Ekol. 2008;9:18–22. [In Russian]
17. Øvrum A, Skandfer S, Nikanov AN, Siurin SA, Talykova LV, Khokhlov T. Vozdeistvie obchshej vibratsii na shakhterov podzemnykh rudnikov; rossiyskiy I evropeyskiy metody otsenki riska i rasprostranennocti boley v poyasnitse. Materialy VIII Vserossiyskogo Kongressa "Professiya i zdorov'e". Moskva, 25–27 noyabrya 2009 goda 2009. [Whole body vibration exposure in underground miners: Russian and European risk assessment methods and low back pain prevalence. Materials of All-Russian VIII Congress "Occupation and Health" Moscow, November 25–27 2009.] Moscow: All-Russian VIII Congress "Occupation and Health"; 2009. p. 363–5. [In Russian]
18. Karnachev IP, Efimova TI, Nikanov AN. Obespechenie bezopasnosti truda v proizvodstvennoy sfere [Summary of the health effects on mine workers in the Kola Arctic]. Apatity: Kola Science Center press; 2006. p. 60–4. [In Russian]
19. Øvrum A, Skandfer S, Nikanov AN, Siurin SA, Khokhlov T. Comparing the WBV exposure hazard by applying the action and limit values in EC directive 2002/44/EC and hazard grades in Russian regulations [Abstract]. Montreal: 4th International Conference on Whole Body Vibration Injuries, Concordia University; 2009.
20. Kola Research Laboratory for Occupational Health. Organisatsiya provedeniya predvaritel'nykh i periodicheskich meditsinskich osmotrov naseleniya, rabotaushchsego na predpriyatiyakh i uchrezhdeniyakh v usloviyakh vozdeistviya vrednykh i opasnykh proizvodstvennykh faktorov. Metodcheskie rekommendatsii dlya lechebno-profilaktcheskikh uchrezhdeniy, tsentrov Gossanepidnadzora i otdelov okhrany truda i techniki bezopasnosti predpriyatiy Murmanskoj Oblasti [Methodical recommendations: Organization of pre- and periodic medical examinations of the people who are working for enterprises and institutions and being are exposed to dangerous and harmful industrial factors. Methodical recommendations for treatment-and-prophylactic institutions, state sanitary-epidemiological supervision centers and departments of labor protection and safety of the Murmansk region

enterprises]. Kirovsk: Kola Research Laboratory for Occupational Health; 2002. 45 p. [In Russian]
21. Kosarev VV, Lotkov VS, Babanov SA. Sovershenstvovanie kachestva organizatsii meditsinskikh osmotrov rabotayushchego naseleniya [Improvement of the quality of organization of medical examinations of a working population in Russia]. Zdravookhranenie Rossiyskoy Federatsii [Health Care of the Russian Federation] 2008;6:11–14. [In Russian]

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